

---

---

# A Web Based E-Waste Management and Collection System: A Futuristic Approach

Raktim Sharma<sup>1</sup>, Sarkar Sujoy Sarathi Das<sup>2</sup>, Md. Mostofa Nurannabi Shakil<sup>3</sup>  
and Md. Sobuz Al Mamun<sup>4</sup>

<sup>1</sup>Bangladesh University of Engineering & Technology, raktims20@gmail.com

<sup>2</sup>Bangladesh University of Engineering & Technology, dsujoy35@gmail.com

<sup>3</sup>Programmer, Skill Development for Mobile Game and Application Project  
ICT Division, shakilcse9@gmail.com

<sup>4</sup>Skill Development for Mobile Game and Application Project, ICT Division, sobuz121@gmail.com

## **ABSTRACT**

*E-waste which can be defined as discarded electronic products contains extremely hazardous materials such as Lead, cadmium etc. In Bangladesh, almost 2.7 million metric tons of e-waste generated per year. E-waste and its reuse and recycling processes can cause significant environmental and health hazards. The current practices of e-waste recycling in Bangladesh suffer from a number of drawbacks. No such factory was setup for recycling because of strategic collection of e-wastes and without regular collection a factory will face losses. Thus, the present informal practice of recycling is not carried out safely and it becomes a danger to human health and the surrounding environment. This paper highlights on strategic method of e-Waste management, collection and selling to the recyclers. It also describes the present dumping practices and what rules are in place for dumping and how futuristic dumping practices can be introduced. Therefore, this paper also suggest that e-waste collection & recycling may require a more customized approach and it should get more preference with municipal solid waste. A comparison of e-waste management framework is also provided emphasizing on e-waste collection.*

**Keywords:** *e-Waste; Recycling; Environment; Precious Metal; Collection Network; e-Waste Management;*

## **1. INTRODUCTION**

Electronic waste(E-waste) is defined as electrical and electronic goods including computers, entertainment devices, phone sets / mobile phones, and other items such as television sets and refrigerators nearing the end of their "useful life and discarded by their original owners [1-3]. Since E-waste contains heavy metals and toxic substances (Mercury, Lead, Cadmium, Zinc, Chromium etc) its improper handling causes harm to human health such as Cancer, Asthma, nerves breakdown, hearing problem, visual problem, Infant-mortality, disable baby birth and also harm to the environment such as the environment air pollution, water pollution, land pollution and life threat for wildlife [1-2, 4-6]. It is estimated that the world generates around 20–50 million tonnes of e-waste annually, most of it from Asian countries. It has been found in a survey that Bangladesh is generating roughly 2.8 million metric tons of e-waste which without knowing the harmful effect is dumped in to the open landfills, farming land and in the open sources of water bodies [2-7]. On the other hand, proper management of E-waste brings a lot of benefits. Recycling which occurs predominantly in poor countries, can recover lots of reusable components and base materials [2,7]. Metal resources retrieved from recycled materials yearly are added to the existing ones for the manufacturing of new products. Precious metal concentrations can be reclaimed from printed circuit boards which is over ten times that of commercially mined minerals; 45% of cathode ray tube materials can be retrieved and platinum group metals can be recover from electrical materials and about 95% of useful materials can be retrieved from computer systems [8-9]. Recycling also have a lesser negative effect on the earth's ecology when

---

compared to land filling E-wastes. So far there are a number of studies have been conducted on E-waste assessment and awareness creation but very less has been done in incorporating information and communication technology for its safe management which in turn indicates that there are scopes of research in the said area.

In recent years due to increasing demand of technology adaption and rapid growth of economy of Bangladesh, a demand driven market has grown for smart phones, feature phones, computers, laptops, consumer electronic products and smart home appliances. This growing market results an increase in the amount of local consumer products in the market and a significant number of quality/ low quality electronic products needs to be disposed off after few years of use which ultimately create a new environmental issue. In Bangladesh, the e-waste is reused, broken down for parts or disposed off completely. Sometimes they are burnt in the open air, some of them are exported to China, India and then reimported illegally in Bangladesh.

Solution of getting rid of such serious problem is recycling them and obtain precious metals such as gold, silver, palladium, platinum etc [9-10]. In western countries e-Waste is collected in separate container and disposed in a different manner. But in regular process 20-30% of total e-Waste is recycled and the rests are either burnt in fire or landfilled [11-13]. An e-waste recycling factory can be economically viable if it has regular collection to recycle. Bangladesh government produces a lot of e-Wastes each year and instead of disposing them to recyclers some organization resells in auction. Thus, the organization and its users suffer from identity theft. Because lot of information can be recovered even after formatting the disk/storage drives. Without proper certification and verification. Main objective of this project are as follows

- Redesign Collection approaches of e-Waste from Residential and Commercial Place with the software system.
- Awareness Building about the harmful nature of e-Waste.
- Propose a 3-tier framework which includes e-Waste collection, import/ manufacture policy and include in the software system.
- Develop a mobile app to collect e-Waste from users.

Recycling also have a lesser negative effect on the earth's ecology when compared to land filling E-wastes. So far there are a number of studies have been conducted on E-waste assessment and awareness creation but very less has been done in incorporating information and communication technology for its safe management which in turn indicates that there are scopes of research in the said area.

## **2. METHODOLOGY FOR COLLECTION OF E-WASTE**

The problem of e-Waste collection is that people do not have enough understanding about hazardous elements in e-Waste. Thus, most of this waste electronic products are kept in possession of its consumers. A mobile app will be developed by which its consumers can dispose the wastes to nearest collection hubs. Users will be registered with name, email, mobile and address. User will request in the app to collect his wastes along with Collection location and information of the wastes (Ex: Laptop 2pcs, iPhone5 3pcs, 55" LED TC etc.). To encourage the user a seed money will be paid against collected products. These wastes will be stored in a collection hub of certain area and after inspection and dismantle these wastes will be resold to the proper recyclers. When collection will reach to a threshold factory setup will be easy for recycling business. Meanwhile, an agreement can be made with Governments, associations of IT Sector (Ex: BASIS, BACCO, BCS, BMBA), Garments Sector, Banking Sector, Telecom Sector to become their e-Waste disposal partner.

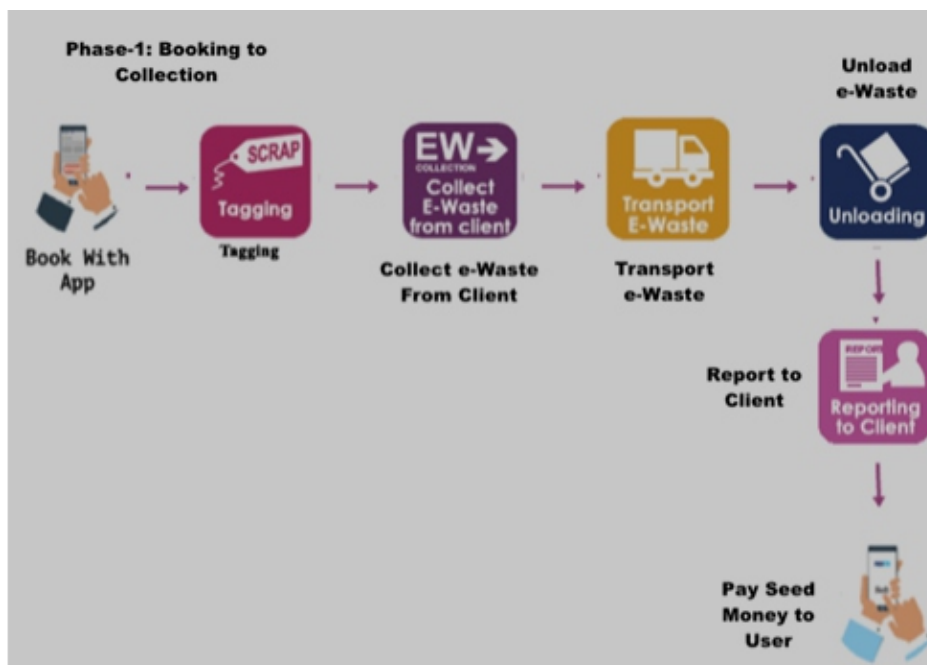
---

In the backend, the App will communicate through an API. All the data will be synchronized in the Web. Data visualization technique will be applied to collaborate with users, Pick up service providers and recyclers. A framework is developed starting from e-Waste/ electronic products manufacturing/import policy, e-Waste collection, disposal, resell and recycling.

The whole process is divided into three phases

### Phase-1

- Using the system registered users will book through the mobile app to sell products.
- Collector will visit the address within given time and Barcoded Tag will be added to the scrap.
- E-Waste will be collected from the user.
- Wastes will be transported safety measures.
- Then unloaded in the warehouse and the inventory will be updated
- After Receiving and checking user will be notified through the app
- A seed money will be sent to the user account.



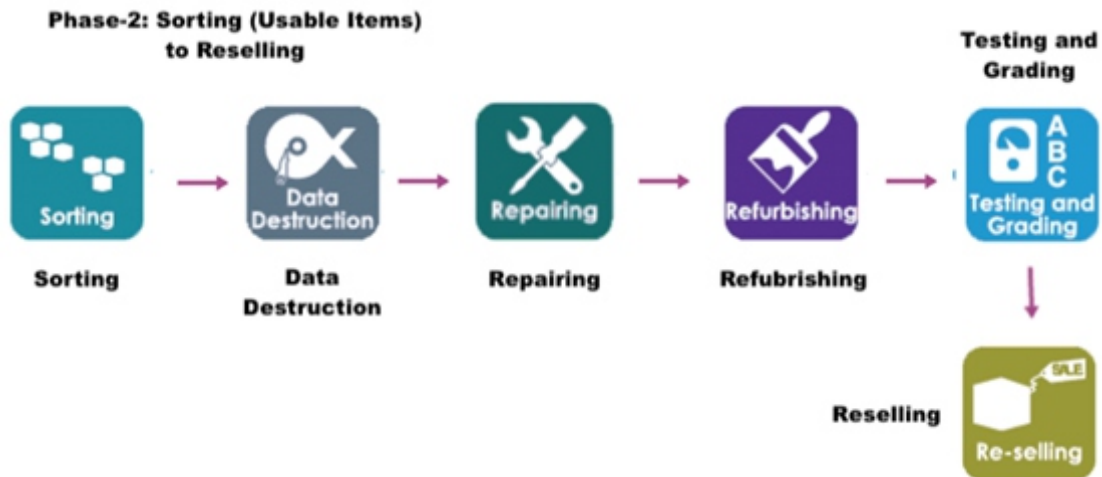
**Fig. 1 Phase-1 from booking to collection to warehouse**

### Phase-2

- After Receiving the products, they will be sorted based us reusable/ unusable items.
- After verification of the products the quoted amount will be paid to the user and the order will be updated from processing to Completed
- With the permission of the user data from memory devices will be destroyed/ recovered.
- They will be repaired, refurbished and then tested.

---

After grading them they will be resold



**Fig. 2 Phase-2 from Sorting (Usable Items) to Reselling**

### Phase-3

- Unusable items will be sorted and stored separately
- Parts will be dismantled and parts will be recovered if possible
- Recoverable components will be tested, graded, resold.
- Unusable items will be shredded and recycled.



**Fig. 3 Phase-3 from Sorting (Unusable Items) to Recycling**

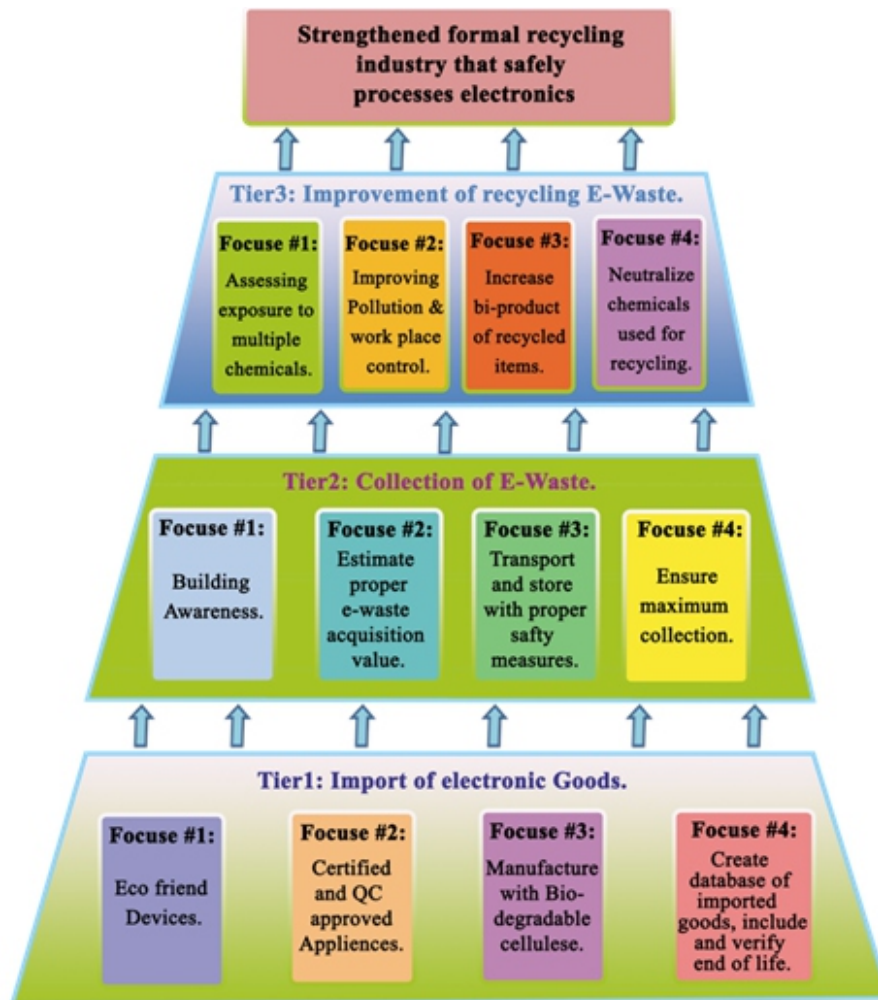
### 3. PROPOSED FRAMEWORK

Some number of frameworks has been developed for e-waste management with a limitation that most of them are proposed for developed countries. It was also difficult to compare the different framework and studies proposed. Since in developed countries e-Waste recycling has industry certification programs that set standards for safer recycling and disposal of electronic waste. Specifically, the Responsible Recycling Practices (R2) and e-Stewards® certification programs include guidelines for responsible and effective e-waste management including environmental and occupational safety and health; the Recycling Industry Operating Standard® (RIOS) defines an integrated quality, environment, health and safety management systems standard for the industry. we acknowledge that many variables are at play in strengthening the e-recycling industry. We emphasized on import policy of electronic products, e-waste collection and awareness building among the users. In Three Tier framework

---

### Tier-1: Import/ Manufacture of Electronic Goods

- Import of Eco-Friendly electronic Devices.
- Import certified and QC approved appliances.
- Manufacture devices with biodegradable cellulose.
- Create database of imported goods and incorporate End of Life of those goods. Ensure a verification of EOF.



**Fig. 4 Three Tier Framework for e-Waste recycling Management**

### Tier-2: Collection of e-Waste

- Building Awareness among users.
- Estimate Proper e-waste acquisition Value otherwise users will not be interested in selling their scrap products. Data Destruction/ Safety policy should also be included.
- Since they are harmful and hazardous for environment they need to Transport and store the scraps with proper safety measures.
- Maximum collection needs to be stored and a chain of this business need to be intact.

### Tier-3: Improvement of e-Waste Recycling

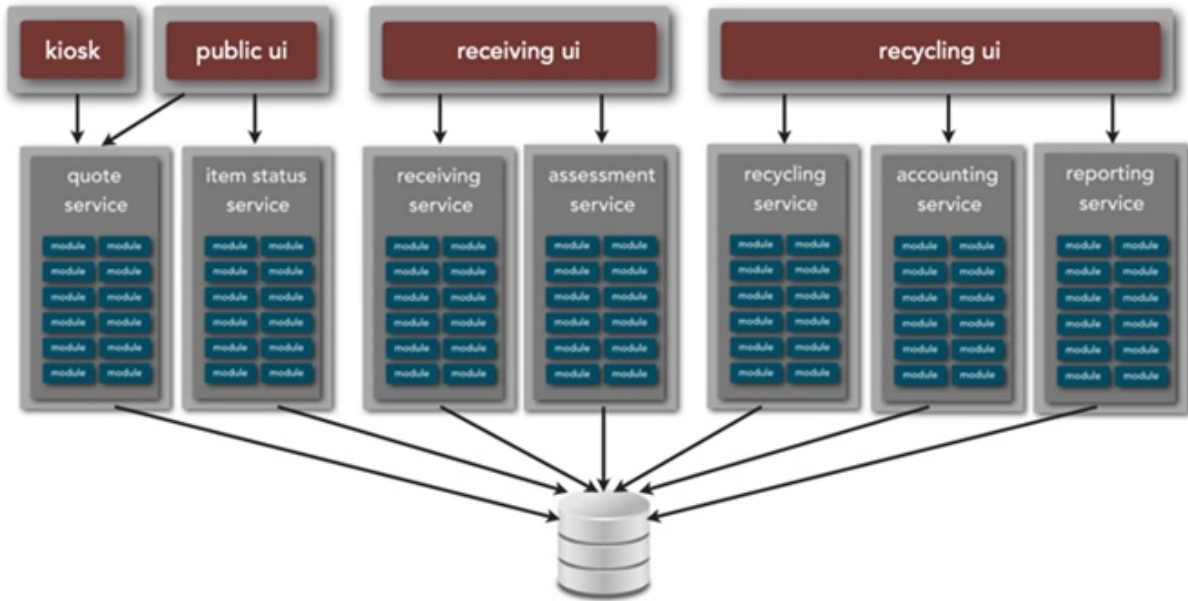
- Assessing exposure to multiple chemicals.
- Improving pollution and workplace control.
- Increase Bi-Product of recycled items.
- Neutralize Chemicals used for Recycling



#### 4. SYSTEM ARCHITECTURE

The system is developed by following Service Based Architecture. Reason behind choosing this architecture are as follows.

- allows for transformation of contract differences.
- allows for non-transactional orchestration of service
- allows for protocol-agnostic heterogeneous interoperability
- allows for common processing logic across all services



**Fig. 5 Architecture of the Software System**

#### 4. RESULTS

The developed framework has been Compared with several frameworks proposed for different countries. Since different countries has different policies and human interaction changes on different demographics, comparisons have been made against few domains. Tiers of Framework, Actors in the framework, Demographic areas, Prime focus in the framework.

**Table 1. Comparison of Different Frameworks**

Frameworks	Demographic Area	Actors of the Framework	Prime Focus	Tiers of Framework
G.Fathima, L.Apparna, V.Kusuma, G.Nischitha [10]	Developed Country	*Government	Recycling	Two
		*Recycling Agent		
MANUEL ROLDAN J [11]	Developed Country	*Manufacturer	Recycling	Two
		*Recycler	Consumers	
		*Consumers		
This Work	Developing Country	*Manufacturer	Recycling	Three
		*Collectors	Environment	
		*Recycler	Consumers	
		*Consumers	Collection	
		*Government Agency	Industry Development	
		*Environment Stakeholders	Import/ Manufacture Policy	
	Awareness Building			

---

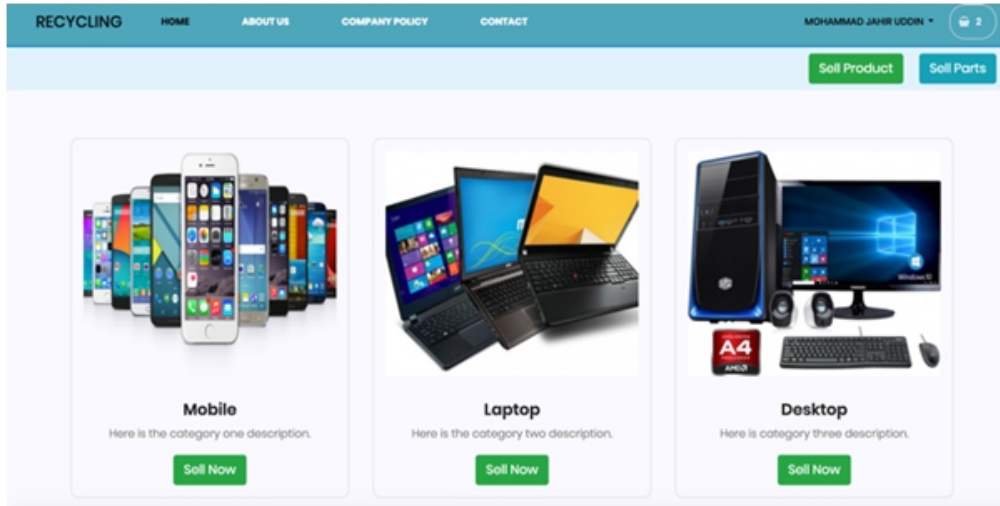
## 5. CONCLUSION

Among many, E-waste is one of the deadliest wastes which has increased exponentially in very short span of time and if not regulated wisely may prove to be dangerous not only to human but entire species living on earth. Invasion of e-Waste has added more complication for waste management in. This project can serve the urgent need and can also put notable contribution in the future policy adaption. It will ease the process the way of collection for end users. It will also encourage Establishment of e-waste collection, exchange and recycling centers in partnership with private entrepreneurs and manufacturers.

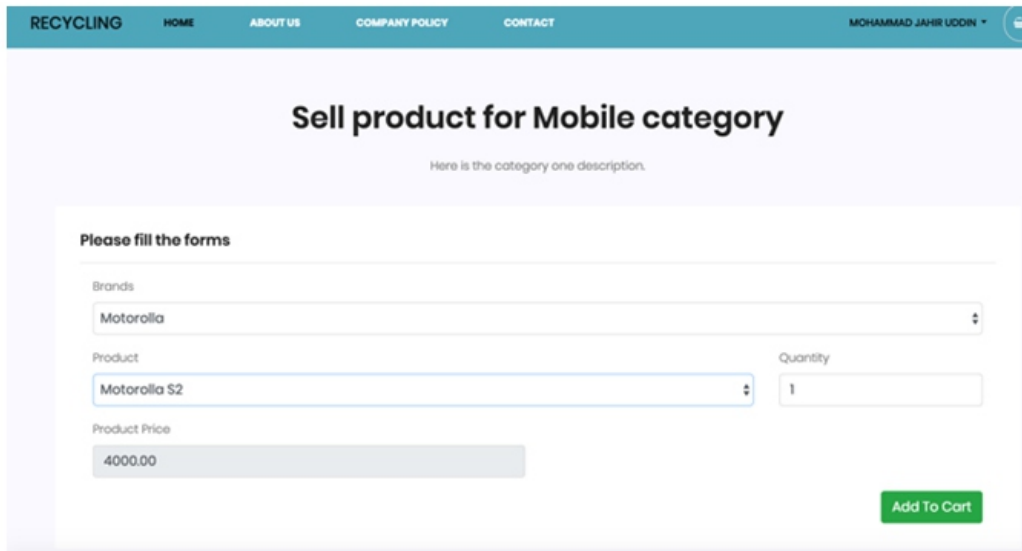
## 5. REFERENCES

1. NNOROM, I. C. AND OSIBANJO O. (2008). "Overview of electronic waste (e-waste) management practices and legislations, and their poor applications in the developing countries." *Resources. Conservation and Recycling* 52(6): 843-858
2. CHATTERJEE S, AND KUMAR K, (2009), *Effective electronic waste management and recycling process involving formal and non-formal sectors, International Journal of Physical Sciences*, 4(13), pp 893-905.
3. HUSNÍK, L., LHOTSKÁ, L. About Poster 2005. In *Proceedings of the 9th International Student Conference on Electrical Engineering POSTER 2005. Prague (Czech Republic), 2005, p. 1 – 2.*
4. BABU, B. R., PARANDE, A. K., & BASHA, C., A. (2007). *Electrical and electronic waste: a global environmental problem. Waste Management & Research*, 25(4), 307-318
5. ALAM M, BAHAUDDIN K. *Electronic Waste in Bangladesh: Evaluating The Situation, Legislation And Policy And Way Forward With Strategy And Approach, PESD, VOL. 9, no. 1, 2015*
6. CEBALLOS D., CHEN L., PAGE E., ECHT A., OZA A., RAMSEY J. *Health Hazard Evaluation Report: evaluation of Occupational Exposures at an Electronic Scrap Recycling Facility.*
7. VIVIAN W. Y. AND TAM C. M., "Waste Levels Reduction by using Stepwise Incentive System: A Hong Kong Study" *Building Research and Information*, pp. 1- 41, 2013.
8. SHAGUN S., KUSH A., AND ARORA A. "International Journal of Future Computer and Communication", Vol. 2, No. 5, October 2013, *Proposed Solution of e-Waste Management.*
9. FATHIMA G, APPARNA L., KUSUMA V., Nischitha G, "International Journal of Latest Engineering and Management Research (IJLEMR)", Volume 02 - Issue 03, | March 2017, PP. 29-34, *A FRAMEWORK FOR E-WASTE MANAGEMENT.*
10. MANUEL R. J, *E-waste management policy and regulatory framework for Saint Lucia Contract No. ITU-SSA No. 12843, February 6, 2017*
11. OGUCHI M., MURAKAMI S., SAKANAKURA H., KIDA A., KAMEYA T. A "Preliminary categorization of end-of-life electrical and electronic equipment as secondary metal resources". *Waste Manag.* 2011, 31, 2150–2160. and *electronic equipment as secondary metal resources". Waste Manag.* 2011, 31, 2150–2160.
12. PARAJULY K., THAPA K.B., CIMPAN C., WENZEL H., "Electronic waste and informal recycling in Kathmandu, Nepal: Challenges and opportunities." *J. Mater. Cycles Waste Manag.* 2017
13. NITYA P. *Cash for Laptops Offers 'Green' Solution for Broken or Outdated Computers.* [Online]. Available: <http://green.tmcnet.com/topics/green/articles/37567-cash-laptops-offers-green-solution-broken-outdated-computers.htm>.

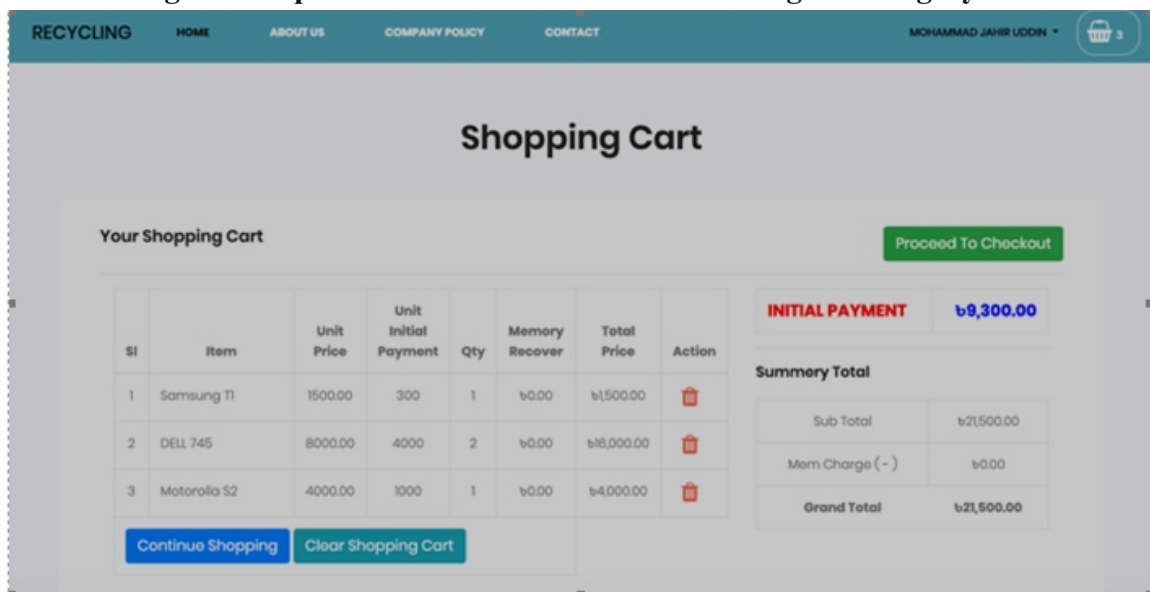
## 6. ANNEXURE



**Fig. 6 A Snapshot of Selling Different Waste Products**

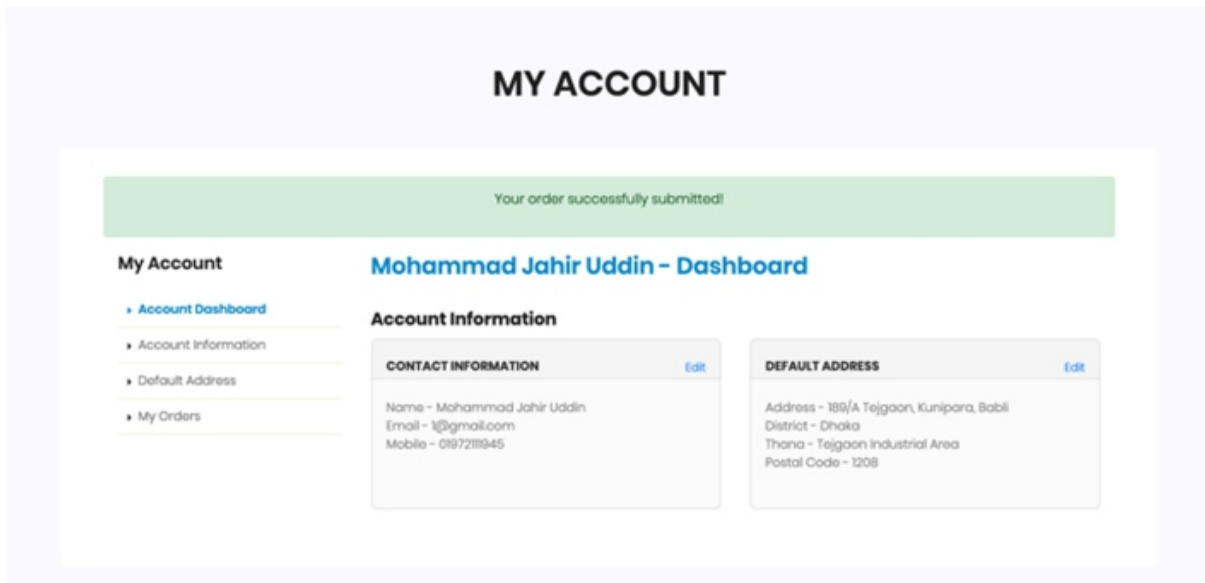


**Fig. 7 A snapshot to select Product after selecting the category**

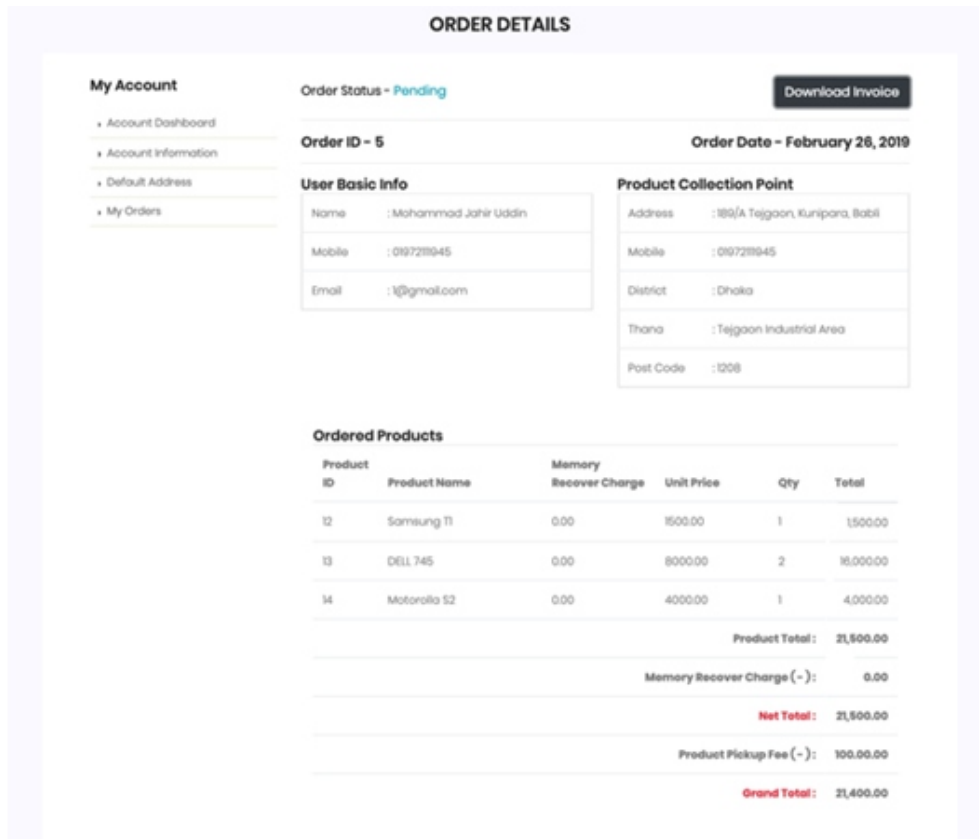


**Fig. 8 A snapshot of Placing order in the card for pick up**





**Fig. 9 A Snapshot of Pickup Confirmation**



**Fig. 10 A Snapshot of Invoice of Sold Products**

Recycling Admin Admin User

Customer Name : Muhammad Jahir Uddin Print Invoice

### Order Status - Completed

**Order Details**

Initial Payment - 5,300.00

Status: Complete

Payment Method: bkash

Complete Note: Missing Parts

Update

**Order ID - 5** Order Date - February 26, 2019

Product ID	Product Name	Memory Recover Charge	Unit Price	Qty	Total
12	Samsung T1	0.00	1300.00	1	1,300.00
13	DELL T45	0.00	8000.00	2	16,000.00
14	Microbia S2	0.00	4300.00	1	4,300.00
<b>Product Total :</b>					21,600.00
<b>Memory Recover Charge (-) :</b>					0.00
<b>Net Total :</b>					21,600.00
<b>Product Pickup Fee (-) :</b>					100.00
<b>Grand Total :</b>					21,400.00
<b>Adjusted Amount (-) :</b>					16,000.00
<b>Adjusted Total :</b>					5,400.00

**User Basic Info**

Name : Muhammad Jahir Uddin

Mobile : 01972111945

Email : t4@gmail.com

**Product Collection Point**

Address : 185/A, Tappan, Kurpiara, Baril

Contact Mobile : 01972111945

District : Dhaka

Thana : Tappan Industrial Area

Postal Code : 1208

**Fig. 11 A Snapshot of Order Completed and Payment Received by the user**